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BIOLOGICAL SYSTEMATICS IN THE SERVICE OF SCIENCE AND PRACTICE

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BIOLOGICAL SYSTEMATICS IN THE SERVICE OF SCIENCE AND PRACTICE

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The fauna of the Soviet Union comprises more than 100 thousand species, while the entire known animal kingdom of the Earth numbers considerably more than a million species; there are perhaps half this number of species in the plant kingdom. Each year taxonomists find many thousands of organic forms previously unknown to science, and we will not be greatly in error if we estimate the total number of species of organisms on our planet to be at least 2-2.5 million. Such are the biological resources of the Earth. If we imagine that each species has an unduplicated set of characteristics and distinguishing features which define it exclusively, it becomes clear how prolific nature has been on our planet.

Man is directly affected by many different organisms. In some cases these are suppliers of various biological products, from food and industrial raw materials to medicinal and other biologically active substances. In other cases, they are an extensive system of animals and micro-organisms which accomplish the decay and mineralization of

of dead biological products, thereby performing an enormous job of sanitation as well as aiding the formation of soil deposits, the major natural agent of growth. In still others, they are plant-pollinators which include various groups of insects, bees in particular, which play a role in the production of seeds and fruit by plants. Finally, they may be disease-causing organisms, pests, parasites, predators, which damage the health of humans, domestic animals, and cultivated plants, or which, by contrast, limit the multiplication of harmful organisms and thereby are beneficial to man.

Obviously, every species, whether or not it is of immediate practical importance to men, is a part of the natural cycle of matter. On the other hand, it is impossible to predict without detailed study which of the species known at a given time will turn out to be of practical interest or usefulness to man. It is therefore inadvisable to decide to leave a given organism un-investigated.

Modern biology with respect to its scientific problems and research objectives is one of the most extensive and, without doubt, complicated, areas in science. It studies life on the most varied levels--from the molecular and cellular (biochemistry, cytology, various branches of physiology, and to a great extent modern genetics) to that of societies of organisms in the biosphere, the Earth's living envelope (population genetics, ecology of groups, geobotany, biogeography). But few biological sciences have as their constant and immediate objective the study of the organism as a whole; among these few, the most important is systematics--a scientific discipline which studies

flora and fauna to develop criteria for distinguishing species and organizing intra-species forms by genus, family, and other higher taxonomies. It should be recognized that without systematics or its final product, classification, the enormous diversity of organic forms would seem merely as a mass of phenomena inaccessible for study or utilization.

Modern systematics has another important feature: it is the only branch of biology which is concerned with a comprehensive description of species and other taxonomies on all levels of knowledge. The more thoroughly we know the characteristics of species, genera, families, orders, classes and varieties, the closer we will be to the construction of a natural system and a practical analysis of organisms, the deeper we will be able to delve into the specific character of each species or other taxonomy, the better we will understand its role in the balance cycle of substances in nature, and the more possibilities there will be for a practical application of the knowledge we obtain.

Of course, a systematicist does not nearly always make a thorough description of a taxonomic group. In everyday practice, he frequently restricts his analysis to two kinds of factors--morphological and geographic. However, when he encounters a little-known group of organisms or a vaguely-delineated taxonomy, or when he tries to generalize a large number of taxonomic factors, the situation changes. In such cases, decisions must be made between many alternatives, and this requires not only a careful morphological and geographical analysis of the available data, but also naturalistic observation, as well as a

study of the biology and ecology of the organisms, with a consideration of their individual and seasonal variability, polymorphism, distribution of habitat, behavior, food specialization, yearly life-cycle, etc. In especially difficult cases, it is necessary to perform laboratory experiments on the effects of heat, light, humidity and other ecological factors on the morphology and behavior of specimens; alternatively, it may be necessary to make serological and physiological analyses of the properties of the organisms and their secretions, and of individual differences; or, finally, the organisms may be studied on a cellular level (structure and number of chromosomes, physiological properties of the cell, etc.). Here the systematicist crosses the boundaries of his own disciplins and collaborates with the physiologist, biochemist, cytologist, and geneticist.

The notion that systematic zoology and botany have been exhausted as descriptive sciences of the level of the 19th century and that they must now be relegated to the status of special auxiliary sciences, is thoroughly erroneous. With at doubt, the auxiliary role of systematics is great: in almost any biological investigation or practical measure which involves animals, plants, or microorganisms, it is necessary to know first of all with what species we are dealing. An incorrect determination of species may sometimes have far-reaching undesirable consequences, such as wasted time, inappropriate planning of research and practical effort so that money and facilities are expended out of proportion with the value of the research which is accomplished, and so that sometimes even a direct threat to humans results (spreading of

a harmful organism, failure to arrest in time a dangerous disease, etc.) Often, an ignorance or inadequate knowledge of the characteristics of a certain species impedes the solution of important problems which arise in science or in practice.

At the same time, an extensive development and investigation of questions in systematics and diagnostics can be of great scientific and practical value. Thus, the phase theory developed by B.P. Uvarov and later investigators shows that several species of locusts and other insects exist in two forms or phases--an aggressive herd phase and a harmless solitary phase. These forms are so dissimilar morphologically and biologically that they had been considered as entirely different species. It was shown, from many laboratory and field experiments, that transitions between these phases can be produced by the environment and by changes in population density; it was also disclosed that insects in the herd phase are capable of long migrations, and that it is in this phase that they are pests. The practical result of these studies was a re-evaluation of the principles of the control of locusts, and a sharp increase in its effectiveness. Another example is the detailed work on the systematics of malaria mosquitoes, performed some time ago. This work led to a more precise knowledge of the role of single species and sub-species in the carrying of malaria, and their biology and required conditions for breeding; in short, the work served as the scientific basis on which malaria was eradicated in this country and in several countries abroad.

A knowledge of the make-up of the plant and animal kingdom,

and a well-developed systematics constitute the first and unavoidable stage in the expansion of knowledge about nature, especially in little-explored regions, in the waters of seas and oceans, etc.; in short, they represent a major part of the study of the biosphere and its resources. Startling discoveries can be made in this area at the present time. An example is the work of A.V. Ivanov on pogonophora, which was awarded the 1961 Lenin Prize; this new species of animal discovered in oceanic depths was unknown to earlier investigators.

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One of the most effective means of introducing data of systematics into practice on a large scale is the publication of summary works "Fauna of the USSR," "Flora of the USSR," and of identification handbooks. The preparation of such systematics monographs requires elaborate scientifically-prepared specimen collections which will serve as a standard for comparison. The collections of the Zoological Institute and the herbarium of the Botanical Institute imeni V.L. Komarov of the Academy of Sciences USSR in Leningrad are outstanding for their comprehensiveness and scope; these serve as a nation-wide source of comparison. There are also some rather extensive collections at the academies of science of Union republics and at certain universities. These regularly-augmented collections promote comprehensive systematics investigations, the development of systematics as a whole, and, finally, the utilization of systematics data in science and practice.

Publications like "Fauna of the USSR" and "Flora of the USSR,"

which now number over 110 volumes, are unequalled anywhere in regard to the scope of systematics work and territorial coverage, and enjoy deserved recognition here and abroad. But their preparation required an enormous amount of labor. Suffices it to mention that the 30-volume "Flora of the USSR," which includes only the higher plants, is the product of thirty years of effort, not counting extensive and prolonged preparatory work. The more than eighty volumes of "Fauna of the USSR" which have been issued in the past thirty years cover only a small portion of the animal kingdom of this country, and the completion of the entire job is contemplated only at some rather distant future time. With this in mind, the Zoological Institute about fifteen years ago undertook the publication of abridged systematic handbooks on the fauna of the USSR, arbitrarily naming them "Minor Fauna." An example is our joint effort with L.L. Mishchenko, "Locust Fauna of the USSR and Neighboring Countries" (1951), which includes 333 forms; the preparation and publication of this work required five years of labor by two scientists, whereas the treatment of these forms for "Fauna of the USSR" would have been a job at least three times that size.

However, even "Minor Fauna" cannot keep up with the growing demands of science and practice, since even this publication will require many decades before it encompasses all the groups of animals in the USSR. A partial solution to the problem which has arisen is the publication of regional handbooks, each for a separate section of the territory of the USSR. Such a measure, of course, does not in the least exclude work on the "Minor Fauna" and the principal "Fauna of the USSR," but can

allow the everyday needs of science and practice to be met more rapidly.

One of these publications is the "Identification Handbook of Insects in the European USSR", which was begun at the Zoological Institute in 1961 and is expected to require five to seven years. It was found possible to reduce the entire handbook to five volumes containing a total of about 330-350 printed pages. The more extensive Volume I, which includes identification tables of 20 orders with about 4500 species (apterygota, pterygota, and varieties with incomplete metamorphoses), has already been prepared for publication. The second volume, which will cover the largest order coleoptera, and orthoptera. Volume III will be devoted to lepidoptera, trichoptera, and neuroptera; IV will cover hymenoptera, and V will cover diptera and aphaniptera. The handbook will include all genera and all or the overwhelming majority of species of insects indigenous to the European part of the USSR (with the exception of species which are confined to a small area, or which have not been sufficiently studied, or which are of no interest whatever at present). In place of detailed descriptions of the various species, only brief data will be given on their geographic distribution (for example, central region, south, south-east, forest-steppe, Southern Crimea, Caucasus, etc.) and ecology (damp meadows, saline soil, plant of whatever type, etc.) Special attention will be given to species which are of practical importance (harmful to plants, animals, and humans, including disease carriers).

The work on the handbook is being done by more than 50 entomological systematicists of the staffs of the Zoological Institute (about half of

the total number of authors) and other scientific and academic institutions of Leningrad, and also of Moscow, Kiev, Khar'kov, Chernovtsy, Stavropol', Ivanov, Riga, Tartu, Tashkent, and other cities. As a result, it was possible to practically finish Volume I in two years, inspite of great difficulties due to inadequate knowledge about many species, genera, families, and other higher groups as a whole, requiring a critical review of the accumulated data, and in some cases a scientific revision of certain genera and families.

It seems to us that the publication of such regional identification handbooks will not only aid scientists and people who are dealing in practice with problems of crop protection, medical and veterinary entomology, biologists of various specializations, regional specialists, teachers and students in higher and special intermediate academic institutions, organizations concerned with forestry, agriculture, and public health, but will also play an important role in future studies of nature in the USSR and of its resources.

Our country is making rapid strides in raising the level of the national economy, public health, science and technology; science itself is becoming a productive force in society. The matrix biological sciences--zoology and botany, and in particular systematics as a scientific basis for knowledge and control of the organic world--will make their contribution to the public and national movement on the road of progress.

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